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The reluctance of cattle to change a learned choice may confound preference tests

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References

Arnold, G.W. and Maller, R.A., 1977. Effects of nutritional experience in early adult life on the performance and dietary habits of sheep. Appl. Anim. Ethol., 3: 5–26.

Bailey, D.W., Rittenhouse, L.R., Hart, R.H., Swift, D.M. and Richards, R.W., 1989. Association of relative food availabilities and locations by cattle. J. Range Manage., 42: 480–482.

Goss, A.E. and Wischner, G.J., 1956. Vicarious trial and error and related behaviour. Psychol. Bull., 53: 335.

Grandin, T., Curtis, S.E., Widowski, T.M. and Thurman, J.C., 1986. Electro-immobilization versus mechanical restraint in an avoid-avoid animal choice test for ewe. J. Anim. Sci., 62: 1469–1480.

Hitchcock, D.K. and Hutson, G.D., 1979. The movement of sheep on inclines. Aust. J. Exp. Agric. Anim. Husb., 19: 176–182.

Hughes, B.O., 1976. Preference decisions of domestic hens for wire or litter floors. Appl. Anim. Ethol., 2: 155–165.

Hutson, G.D., 1981. Sheep movement on slatted floors. Aust. J. Exper. Agri. Anim. Husb., 21: 474–479.

Muenzinger, K.F., 1938. Vicarious trial and error at the point of choice. A general survey of its relation to learning efficiency. J. Gen. Psychol., 53: 75.

Pollard, J.C., Littlejohn, R.P. and Suttie, M., 1993. Responses of red deer to restraint versus no restraint in a Y maze preference test. Australian Society for the Study of Animal Behaviour, Department of Psychology, University of Canterbury, Christchurch, New Zealand, (Abstract).

Stewart, P.J., Arave, C.W. and Dias, B., 1992. The effect of observation on Holstein heifer's learning ability in a closed field maze. J. Anim. Sci., 70(Suppl. 1): 155 (Abstract).

Uhrbrock, R.S., 1969. Bovine laterality. J. Genetic Psychol., 115: 77–79.

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Abstract

Choice testing utilizing a Y-maze has been successfully used to test animal preferences. In this experiment, 12 female Angus×Hereford×Simmental×Charolais heifers were given a choice of walking through a squeeze chute (crush) or being restrained in a squeeze chute. The objective of the study was to determine if previously learned choices in a Y-maze would confound future choices. A start box led to two races in a Y configuration. There was a hydraulic squeeze chute at the end of each race. Animals that chose the right side were allowed to walk through the squeeze chute and animals that chose the left side were restrained in the squeeze chute for 30 s. During eight choice trials, the heifers had a definite preference for the 'walk' side. There were 64 walk choices and 32 'restraint' choices. For six additional trials, the restraint and walk sides were switched. Walk choices dropped to 16 and restraint choices rose to 56. The resistance to switching effect was significant ($P<0.01$). Significantly more heifers vacillated (looked back and forth) at the decision-point after the sides were switched ($P<0.01$). The switch had been perceived by the animals. There is a tendency for cattle to resist changing a choice once they are accustomed to a treatment being associated with a specific side.

Key words: Welfare; Choice test; Preference test; Restraint; Handling

Introduction

Choice tests and preference tests are important for answering many animal welfare questions. Y-maze and T-maze choice tests have been used to study preferences in farm animals (Hughes, 1976; Hitchcock and Hutson, 1979; Hutson, 1981; Grandin et al., 1986; Pollard et al., 1993). They are especially useful for

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determining the relative aversiveness of different husbandry or handling procedures. Since preference testing may be used to make legislative decisions concerning animal welfare, it is essential that preference test results are not confounded by variables such as previous learning. Previous experiences can affect choices. For example, grazing preferences in sheep are affected by previous experience (Arnold and Maller, 1977). Another example is that rearing environment can affect flooring preferences in caged hens (Hughes, 1976). The purpose of this experiment was to determine if previous experiences in a Y-maze testing facility affects future choices.

Animals, materials and methods

Twelve 365-kg heifers that were crossbreds of Angus × Hereford × Charolais × Simmental were used. The heifers were housed in outdoor feedlot pens adjacent to the choice testing facility. The test facility was constructed from 1.52-m-high solid steel fences (Fig. 1). It consisted of a crowding pen, single file race, start box and two races in a Y configuration which led to two identical hydraulic squeeze chutes (crushes; Bowman Livestock Equipment, Council Grove, KS, USA; Fig. 2). The squeeze chutes had hydraulically activated squeeze sides and head stanchions. The start box was used to admit each animal one at a time into the Y decision-point. Solid sliding gates on each end of the start box prevented animals that were waiting in line from observing the choices made by an animal leaving the start box. All animals were allowed to voluntarily leave the start box and they were never touched by a handler until after they had made a decision and had moved into one of the races. This prevented the decision-making process from being confounded by a handler driving an animal. Great care was taken during the entire experiment to prevent the activities of people from affecting the

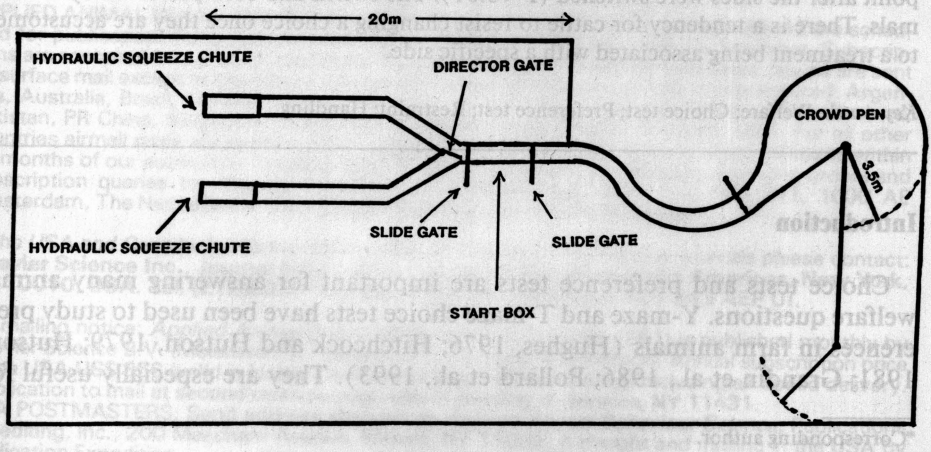

Fig. 1. Layout of preference testing facility.

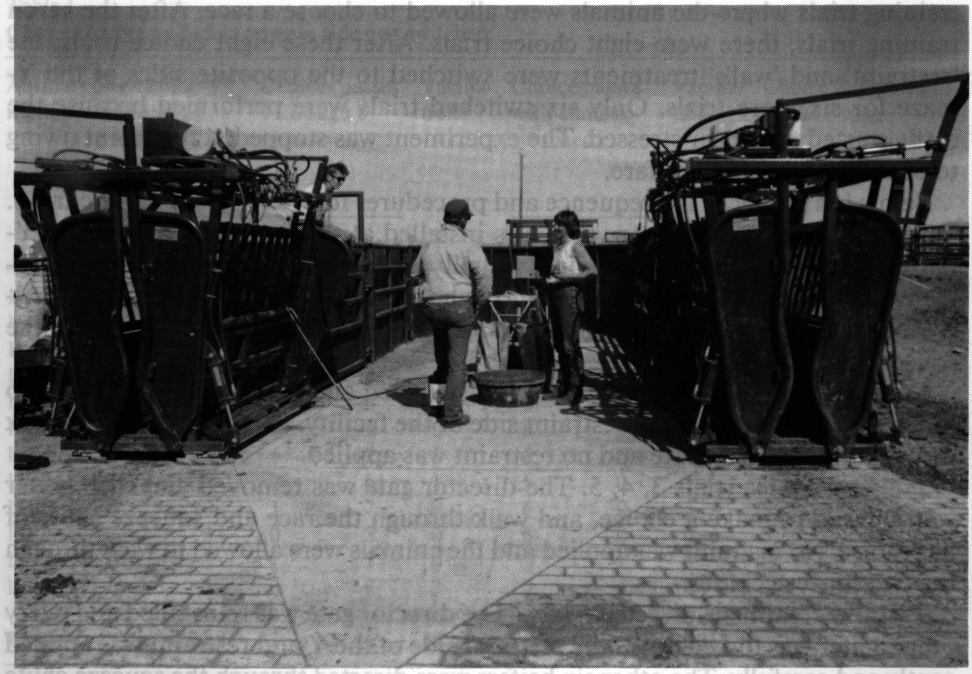

Fig. 2. Hydraulic squeeze chutes used to restrain cattle in the preference test.

animals' choices. No electric prods were used and heifers that voluntarily entered one of the squeeze chutes were not touched in accord with good industry practice. If an animal balked at the squeeze chute entrance, it was tapped on the rump. If tapping failed to move an animal, its tail was twisted to induce it to enter the squeeze chute. To control for the effect of animals seeing people, a person was stationed beside each squeeze chute with his hands on the controls. These people stood completely still until each animal entered the squeeze chute.

The testing procedure was similar to the procedure in Grandin et al. (1986). It consisted of a series of training and choice trials. After all 12 heifers had passed through the facility, they were immediately returned to the crowd pen for the next trial. Both squeeze chute operators were present for all training and choice trials, and the person that drove balky animals into the squeeze chute stood in the exact center between the two races. This person stood absolutely still and did not move from this position unless a heifer balked and stopped near the entrance of a squeeze chute.

There were a total of seven training trials and 14 trials where choices were tabulated. For the first two and last two training trials, the animals were directed by a gate to walk through one side of the Y and then the gate was switched to direct them through the other side. The purpose of the training trials was to teach the animals that the Y-maze had two choices and to ensure that the cattle had experienced both treatments before choices were tabulated. There were also three

training trials where the animals were allowed to choose a race. After the seven training trials, there were eight choice trials. After these eight choice trials, the 'restraint' and 'walk' treatments were switched to the opposite sides of the Y-maze for six more trials. Only six switched trials were performed because the cattle started to appear stressed. The experiment was stopped at this point owing to concern for animal welfare.

Below is a listing of the sequence and procedures for training and choice trials.

Training trial 1. A director gate was installed at the decision-point in the Y-maze (Fig. 1). Each heifer was individually released from the start box and directed by the director gate to move through the right-hand walk side of the facility. No restraint was applied and each heifer was allowed to walk through the squeeze chute.

Training trial 2. The director gate was switched and each heifer was forced to move through the left-hand restraint side of the facility. She was allowed to walk through the squeeze chute and no restraint was applied.

Training choice trials 3, 4, 5. The director gate was removed and each heifer was allowed to make a choice, and walk through the race and squeeze chute of her choice. No restraint was applied and the animals were allowed to walk through the two squeeze chutes.

Training treatment-directed trial 6. The director gate was reinstalled and every other heifer was forced down the restraint side of the Y and restraint was applied gently and carefully. The other six heifers were directed through the squeeze chute on the opposite side of the Y and were allowed to walk through the chute.

Training treatment trial 7. The director gate was kept in place and heifers which had experienced restraint were directed down the walk side and heifers that had experienced the walk treatment were directed down the restraint side. Restraint was applied to heifers on the restraint side.

Choice trials 1 through 8. The director gate was removed and each heifer was allowed to make eight choices. Each choice was tabulated. There was a 1.5-h break after Choice Pass 4.

Switched choice trials 9 through 14. The restraint and walk sides were switched. Heifers which had successfully avoided restraint by choosing the walk side now experienced restraint in the walk side. Each choice was tabulated.

Choice trials 2 weeks later. Each animal was admitted one at a time to the Y decision-point and its choice was recorded. The restraint side was the same side as in switched trials nine through 14. Only one choice trial was possible at this time because the cattle were entering a physiological experiment and there were concerns that more than one trial would confound this experiment.

Results

The cattle expressed a preference for the walk side of the Y race before the restraint treatment side was switched (Table 1). During the first eight choice

Table 1
Choices before and after squeeze side was switched

Animal number	Pre-choice training passes (walk through)		Choices passes 1 through 8		Vacillations	Choice passes with choices switched		Vacillations	Choice 2 weeks later[1]	Resistant to switching[2]
	Squeeze	Walk	Squeeze	Walk		Squeeze	Walk			
1002	0	3	3	5	6	5	1	46	S	
1038	0	3	0	8	1	6	0	4	S	R
1042	2	1	7	1	0	4	2	2	W	
1045	2	1	4	4	0	6	0	2	S	R
1150	2	1	2	6	3	6	0	2	S	R
1161	1	2	6	2	0	6	0	4	S	R
1184	3	0	6	2	0	0	6	4	W	
1189	1	2	2	6	1	6	0	1	S	R
1190	3	0	1	7	2	6	0	3	S	R
1192	0	3	0	8	0	6	0	0	S	R
1197	0	3	1	7	0	5	1	3	S	
1200	0	3	0	8	2	0	6	4	S	
Totals	14	22	32	64	15	56	16	74		

[1]Choice 2 weeks later: S, chose race leading to squeeze; W, chose race leading to walk. Squeeze was tabulated for choices leading to the squeeze after the sides were switched.
[2]Cattle were labelled resistant to switching if they chose the squeeze side for all six choices after the choice sides were switched and they chose the squeeze side 2 weeks later.

trials, there were 32 squeeze choices and 64 walk choices. After the restraint side was switched, there were 56 restraint choices and 16 walk choices. The resistance to switching effect was significant. A paired *T*-test with arcsine transformation of the data was used to determine whether heifers chose the restraint side more after the switch ($T=3.76<0.01$). Two weeks later, the cattle were returned to the facility and ten out of 12 animals chose the restraint side. Seven heifers were extremely resistant to switching. They neither chose the walk side after the restraint side was switched, nor 2 weeks later. All seven chose the restraint side (Table 1). Only two heifers completely avoided the restraint side for all six switched choice trials. One of these heifers (1184) was accidentally caught around the shoulders by the head stanchion during the fifth choice trial prior to switching. She also avoided the restraint side 2 weeks later. Animal number 1200 completely avoided the restraint side for all 14 choice trials, but she chose restraint 2 weeks later.

The number of times each animal looked back and forth before it made a choice (vacillations) was significantly higher after restraint was switched to the other side. Prior to switching sides, there was a total of 15 vacillations and after switching sides, vacillations rose to 72. Heifer 1002 had a very high number of vacillations (46) and may possibly be an outlier that would confound the results. When

her data were removed from the analysis, vacillations were still higher after switching (29 vs 9). A paired T-test indicated that vacillations were significantly greater after switching ($T=3.40<0.01$). Six animals never vacillated during the first eight choice trials and after the sides were switched, all animals except one vacillated ($\chi^2=5.03<0.05$). Eight out of 12 animals never balked and entered the squeeze chute voluntarily. Heifer 1042 balked during choice trials 1 through 8, but she entered voluntarily for the switched choice trials 9 through 14. On three trials, tail twisting was required to induce her to enter the squeeze chute. Animals 1150 and 1197 balked during two trials. Animal 1197 had her tail twisted on choice trial number 13 as she entered the walk side. On the 14th trial, she chose the restraint side after entering the walk side and then backing out of it.

Discussion

The results of this experiment indicate that the tendency of cattle to resist changing a choice once they are accustomed to a treatment being associated with a specific side, could severely confound choice tests. For accurate choice testing results, a new group of naive cattle should be used when the sides of a choice test are switched. Even though most animals persisted in entering the restraint side after the sides were changed, the increase in the number of vacillations indicates that the animals had perceived the switch. Vacillation (vicarious trial and error) occurs when an animal is unsure or learning to discriminate (Muenzinger, 1938; Goss and Wischer, 1956). Even though the animals perceived that conditions had changed, most chose the previously learned safe route.

Stewart et al. (1992) found that cattle could quickly learn a maze. Performance deteriorated when they had to learn a new maze (C.W. Arave, personal communication, 1992). This observation is a further illustration of the bovine's resistance to changing a learned behavior. C.W. Arave (personal communication, 1992) also observed that some heifers persisted in following the pattern of a maze after the partitions were removed. Bailey et al. (1989) reported a similar resistance to change. Steers quickly learned to choose the arm in a five arm parallel maze which contained the most grain. When the location of the largest grain reward was changed it took somewhat longer for steers to learn the new location.

The confounding effects of resistance to switching in choice tests is likely to be greatest when the choices are only mildly aversive. All cattle in the experiment were handled gently and care was taken to avoid banging them on the head with the head stanchion. The restraint and handling procedure was only mildly aversive because most animals moved voluntarily through the system at a slow walk. A previous study by Grandin et al. (1986) in a similar Y-maze choice test indicated that sheep quickly learned to avoid highly aversive electro-immobilization.

They were given a choice between immobilization or a tilt squeeze table. During the pre-choice non-treatment training trials, the sheep preferred walking through the right-hand immobilizer race. Possibly, the sheep initially preferred the immobilizer race because it was wider and easier to walk through than the tilt table. When the treatments were applied, most sheep immediately switched sides to avoid the immobilizer.

A severely aversive treatment may possibly overcome the reluctance of the cattle to switch sides. Heifer 1184 had a more severe aversive experience in the squeeze chute than all of the other cattle because she was accidentally caught around the shoulders. When the sides were switched, she avoided the restraint side. When she returned 2 weeks later, she still avoided the restraint side. The question of laterality in ruminants also needs to be addressed. For example, cattle prefer to lie on the left side (Uhrbrock, 1969). In both Grandin et al. (1986) and this experiment, there was an initial tendency during the training for the animals to prefer the right-hand side. During the three training choice trials, five out of 12 heifers always chose the right-hand side and two heifers always chose the left side. The initial choice of sides tended to persist during the choice trials. However, all heifers except two made different choices during the 14 choice trials.

There was also a tendency for calmness or behavioral agitation to affect choices. Animals 1038 and 1192 were the most resistant to switching sides in the entire experiment. These animals switched sides during neither the pre-choice training trials nor all the choice trials. Both of these animals displayed escape behavior and agitation. Animal 1038 attempted to jump out of the start box several times and 1192 was difficult to chase out of the crowd pen into the start box. She also jammed her head under the start gate. There appeared to be a tendency for all the animals to become slightly more agitated as the experiment progressed. Possibly, calmer animals were able to make more accurate choices to avoid aversive treatment. After the 1.5-h lunch break, animals 1161 and 1045 appeared calmer compared with the fourth choice trial before lunch. They avoided the squeeze chute for the next two to three trials. Calmer animals also had a tendency to vacillate more at the decision-point. The one animal that vacillated 46 times was a calm heifer with a small flight zone. Spacing each choice trial several hours apart instead of 5 min apart may help alleviate this problem. An increased interval between the choice trials could allow the animals to calm down before the next trial.

In conclusion, it appears that previously learned choices may affect future choices in Y-mazes for cattle. Another area that needs to be researched is the effects of a mildly aversive treatment versus a severely aversive treatment on the tendency of a bovine to resist changing a learned choice. The effects of arousal level and excitement on a bovine's choice behavior also needs to be investigated.

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